

WHAT IS CLAIMED IS:

1. An optical element comprising at least:

two substrates that are disposed opposite to each other;
a liquid disposed between facing surfaces of the opposed substrates; and

at least one chargeable polymer particle disposed between the facing surfaces of the substrates for swelling or contracting by absorbing or releasing the liquid when an electric field is applied,

wherein at least one of the facing surfaces includes at least an adhering fixing portion that fixes the chargeable polymer particle thereon and the chargeable polymer particle is fixed to the at least one facing surface via the adhering fixing portion,

wherein

(1) an area of each adhering fixing portion is smaller than a maximum sectional area of the chargeable polymer particle at the time of maximum swelling, and

(2) a non-adhesive portion surrounds each adhering fixing portion, and the non-adhesive portion is disposed at least at a largest outer circumference of the chargeable polymer particle at the time of maximum swelling and extends inside the largest outer circumference of the chargeable polymer at the time of maximum swelling.

2. An optical element according to claim 1, wherein the

chargeable polymer particle is fixed to the at least one facing surface via the adhering fixing portion by at least one kind of chemical bond selected from the group consisting of a hydrogen bond, an ionic bond and a covalent bond.

3. An optical element according to claim 1, wherein a surface of the adhering fixing portion includes a silane coupling agent.

4. An optical element according to claim 1, wherein a surface tension of the non-adhesive portion is 30 mN/m or less.

5. An optical element according to claim 1, wherein a surface of the non-adhesive portion is covered with a fluorine-containing material.

6. An optical element according to claim 1, wherein the liquid is an insulating liquid.

7. An optical element according to claim 1, wherein an electrode is provided on at least one facing surface of the substrates.

8. An optical element according to claim 1, wherein the at least one chargeable polymer particle includes a light controlling

material.

9. An optical element according to claim 1, wherein the at least one chargeable polymer particle includes a chargeable particle.

10. An optical element according to claim 9, wherein the at least one chargeable particle is a light controlling material.

11. An optical element according to claim 9, wherein the at least one chargeable polymer particle comprises a nonionic polymer.

12. An optical element according to claim 9, wherein the at least one chargeable polymer particle comprises an ionic polymer.

13. An optical element according to claim 1, wherein the at least one chargeable polymer particle comprises an ionic polymer.

14. A method for producing an optical element which comprises at least:

two substrates that are disposed opposite to each other;

a liquid disposed between facing surfaces of the opposed substrates; and

at least one chargeable polymer particle disposed between

the facing surfaces of the substrates for swelling or contracting by absorbing or releasing the liquid when an electric field is applied,

wherein at least one of the facing surfaces includes at least an adhering fixing portion that fixes the chargeable polymer particle thereon and the chargeable polymer particle is fixed to the at least one facing surface via the adhering fixing portion,

wherein

(1) an area of each adhering fixing portion is smaller than a maximum sectional area of the chargeable polymer particle at the time of maximum swelling, and

(2) a non-adhesive portion surrounds each adhering fixing portion, and the non-adhesive portion is disposed at least at a largest outer circumference of the chargeable polymer particle at the time of maximum swelling and extends inside the largest outer circumference of the chargeable polymer at the time of maximum swelling,

the method comprising:

a fixation inhibitor providing step of providing the fixation inhibitor to the at least one facing surface;

a fixing agent providing step of providing the fixing agent to the at least one facing surface; and

a patterning step of forming a region on the at least one facing surface to which region at least one agent selected from the group consisting of the fixation inhibitor and the fixing agent can be selectively provided.

15. An optical element comprising at least:
two substrates that are disposed opposite to each other;
a liquid disposed between facing surfaces of the opposed substrates; and
at least one chargeable polymer particle disposed between the facing surfaces of the substrates for swelling or contracting by absorbing or releasing the liquid when an electric field is applied,
wherein at least one of the facing surfaces includes at least an adhering fixing portion that fixes the chargeable polymer particle thereon and the chargeable polymer particle is fixed to the at least one facing surface via the adhering fixing portion,
wherein
(3) an area of each adhering fixing portion is smaller than a maximum sectional area of the chargeable polymer particle at the time of maximum swelling, and
(4) at least one protruding portion is provided on the at least one facing surface and the adhering fixing portion is provided on a surface of the protruding portion.

16. An optical element according to claim 15, wherein a height of the protruding portion is in a range of 1 μm to 100 μm .

17. An optical element according to claim 15, wherein the at least one chargeable polymer particle is fixed to the surface of the

at least one protruding portion via the at least one adhering fixing portion by at least one kind of chemical bond selected from the group consisting of a hydrogen bond, an ionic bond and a covalent bond.

18. An optical element according to claim 15, wherein a surface of the adhering fixing portion includes a silane coupling agent.

19. An optical element according to claim 15, wherein the liquid is an insulating liquid.

20. An optical element according to claim 15, wherein an electrode is provided on at least one facing surface of the substrates.

21. An optical element according to claim 15, wherein the at least one chargeable polymer particle includes a light controlling material.

22. An optical element according to claim 15, wherein the at least one chargeable polymer particle includes a chargeable particle.

23. An optical element according to claim 22, wherein the at

least one chargeable particle is a light controlling material.

24. An optical element according to claim 22, wherein the at least one chargeable polymer particle comprises a nonionic polymer.

25. An optical element according to claim 22, wherein the at least one chargeable polymer particle comprises an ionic polymer.

26. An optical element according to claim 15, wherein the at least one chargeable polymer particle comprises an ionic polymer.

27. A method for producing an optical element comprising at least:

two substrates that are disposed opposite to each other;
a liquid disposed between facing surfaces of the opposed substrates; and

at least one chargeable polymer particle disposed between the facing surfaces of the substrates for swelling or contracting by absorbing or releasing the liquid when an electric field is applied,

wherein at least one of the facing surfaces includes at least an adhering fixing portion that fixes the chargeable polymer particle thereon and the chargeable polymer particle is fixed to the at least one facing surface via the adhering fixing portion,

wherein

(3) an area of each adhering fixing portion is smaller than a maximum sectional area of the chargeable polymer particle at the time of maximum swelling, and

(4) at least one protruding portion is provided on the at least one facing surface and the adhering fixing portion is provided on a surface of the protruding portion,

the method comprising at least a fixing agent providing step of providing the fixing agent selectively to the surface of the protruding portion by using a pattern.